

- i) Engineers to know the tension in the chain
- ii) Engineers to know the magnitude and direction of the reaction between the bar and the wall.

### ITEM 5

During transportation of vaccines to the village by a nurse, they have to be kept at low temperatures so as not to cause distortion of its biological nature.

The vaccines must be transmitted with a temperature range of  $-5^{\circ}\text{C}$  and  $-4^{\circ}\text{C}$ . The vaccines are carried in a vaccine carrier that gains heat at  $200\text{s}^{-1}$ .

The vaccine of a volume of  $100\text{cm}^3$  and a density of  $4\text{gcm}^{-3}$  and specific heat capacity of  $2000\text{Jkg}^{-1}\text{K}^{-1}$  at temperature of  $-5^{\circ}\text{C}$  is packed in the box with  $110\text{g}$  of ice at the same temperature. The nurse rides a motorcycle. She starts from a health center, P and stops to Q which is close to the destination. She accelerates uniformly from P at  $1\text{m}^2$  for  $15\text{s}$  and maintains a constant speed for a time before decelerating uniformly to rest at Q. After resting for  $100\text{s}$  the nurse reaches the destination in the next  $20\text{s}$ .

#### Hint

Distance between P and Q =  $2\text{km}$

Specific heat capacity of ice =  $2100\text{Jkg}^{-1}\text{K}^{-1}$

Specific latent heat of fusion of ice =  $3.36 \times 10^5\text{Jkg}^{-1}$

Specific heat capacity of water =  $4200\text{Jkg}^{-1}\text{K}^{-1}$

**Task:** As a physics learner;

- a) Find whether the vaccine was delivered within the recommended temperature range.
- b) Suggest the precautions the nurse should undertake so as to reach safety

\*\*\*GOOD LUCK\*\*\*

**Task:**

Deliver a lesson to your fellow students in a science club about how light moves in a straight line, the law governing reflection and why the ambulance sign is written in reverse. Use diagram to illustrate your explanation and help students in the club to visualize these concepts.

**SECTION B****ITEM 3**

In a tense foot ball match between rival items "Thunder FC" and "Lightening FC", played under clear skies at the stadium of champions, a critical moment unfolds. With the score tied 2.2 in the dying minutes, Thunder FC's star player takes a free kick from a spot 30m away from the goal posts.

He kicks the ball with a velocity of  $20\text{ms}^{-1}$  at an angle of  $30^\circ$  to the horizontal. The ball arcs through the air, narrowly clearing the horizontal bar of the goal post, much to the dismay of lightening FC's goal keeper, an experienced goal keeper, had positioned himself perfectly but held his hands backwards in anticipation of catching the ball a technique he uses to minimize impact and maximize control.

**Task:**

- i) Help the audience to know the height of the goal post.
- ii) The ball lands 6.8m behind the goal post. Prove whether this is a true statement
- iii) The coaching staff of thunder FC is eager to know why the goal keeper moves his hands backwards while holding the ball.

**ITEM 4**

In the bustling construction site of the "sky line tower", project, engineers are testing the structural integrity of a uniform beam of AB. The beam with a mass of 20000g and length of 2.4m, is hinged at point A on a vertical wall. To maintain the beam in a horizontal position, a chain is attached to end B of the beam and to point C on the wall, which is 1.5m above point A. Adding to the complexity of the step up, a load of 10kg is placed on the beam at point 180cm from hinged end A. The engineers need to calculate critical forces for safety assessments.

**Task:**

As a physics learners help;

## SECTION A

### ITEM 1

A man in an air craft watches two particles travelling along a straight line AB of length 2000cm. At the instant when one particle starts from rest of A and travels towards B with a constant acceleration of  $2\text{ms}^{-2}$ , the other starts from rest at B and travels towards A with a constant acceleration of  $5\text{ms}^{-2}$ .

#### Task:

Help that man to find out the time after which the two particles collide and how far they collide

### ITEM 2

As a leader of science club designing an interactive lesson to help students understand how light behaves. You have set up an experiment to demonstrate how light travels in a straight line and reflects off surface.

As part of the lesson, you want your fellow students to observe how a beam of light passes through a straight path and reflects off a mirror illustrating the law of reflection. To make it more engaging you use the example of an ambulance with the word "AMBULANCE" written in an inverted way on its front as shown below.

